Model PCLD-889

Amplifier/Multiplexer Board

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CHAPTER 1. GENERAL INFORMATION

1.1. Introduction

PCLD-889 is a powerful programmable amplifier and channel multiplexing daughter board for the analog input channels of the PCL-711, PCL-812 and PCL-718 data acquisition card. This daughter board also works with any other data acquisition card which supports both +12V and +5V power supply and 8 bit programmable TTL/CMOS digital control and analog input channels.

This board multiplexes 16 differential input channels into one analog output channel. Up to 10 PCLD-889 can be cascaded to expand the analog inputs of single data acquisition card to 160 channels. The board has a high grade instrumentation amplifier to provide switch selectable or external digital signal programmable gains of 0.5, 1, 2, 10, 50, 100, 200, 1000. This function allows users perform accurate low level analog signal measurement.

Signal conditioning functions like filtering, attenuation, current shunt are also covered by the on-board passive circuitry. PCLD-889 also contains cold junction sensing circuit to allow direct measurement of thermocouple transducer. All types of thermocouple can be handled with software compensation and linearization.

A summary of the PCLD-889 features are as following :

* Multiplexing 16 differential inputs to one analog output channel.
* Expanding analog inputs to the maximum of 160 channels by cascading multiple PCLD-889. (For PCL-711 and PCL-718, the maximum channel number is 128)
* High grade instrumentation amplifier provides switch selectable or external digital signal programmable gains of 0.5, 1, 2, 10, 50, 100, 200, 1000.
* Selectable Remote or Local control gains.

* On-board cold junction compensation circuits for direct thermocouple measurement. The PCL-889 supports type T, J, E, K, R and S thermocouple.

* Build-in signal conditioning functions such as filtering, attenuation and current shunt.

* Screw clamp terminal blocks permits easy and reliable signal connections.

The Appendix A provides the PCLD-889 block diagram and the Appendix B provides the PCLD-889 connectors, switches and VR's location diagram.

1.2. Specifications

Input Channel : 16 differential channels.

Input Range : +/- 10V maximum, varies on the gain selection.

Input Conditions :

Gain	Common Mode Rejection	Non-Linearity	Settling Time *	Max. Input Voltage
1000	125 dB	0.005	0.05 mS	+/- 10mV
100	125 dB	0.005	0.015 mS	+/- 100mV
10	110 dB	0.007	0.013 mS	+/- 1V
1	90 dB	0.015	0.012 mS	+/- 10V
0.5	90 dB	0.015	0.012 mS	+/- 10V

* The filter circuit is removed.

Overvoltage protection : +/- 30V continuous.

Common mode voltage : +/- 10V maximum.

Output range : +/- 10V maximum.

Output current :	20 mA maximum.
Cold junction compensation :	+ 24.4mV/deg. C. 0.0 V at 0.0 deg. C.
Power consumption :	+ 5V (60mA maximum). + 12V (160mA maximum).
Connector type :	
Analog output and digital input :	20 pin flat cable connectors.
Analog input and ext. power :	Screw clamp terminal.
Dimensions :	20.5 cm (L) x 11.43 cm (W) or 8.07" (L) x 4.5" (W).
Weight :	0.563 Lb. (256 gm.)

CHAPTER 2. INSTALLATION

2.1. Initial Inspection

Inside the shipping container, you should find this operating manual and the PCLD-889 board. The PCLD-889 is carefully inspected both mechanically and electrically before shipment. It should be free of marks and scratches and in perfect electrical order on receipt.

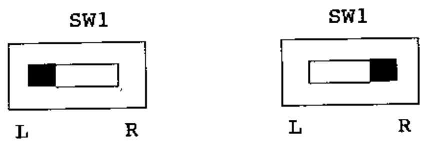
When unpacking, check the unit for signs of shipping damage (damaged box, scratches, dents, etc). If there is damage to the unit or it fails to meet specifications, notify our service department or your local sales representative immediately. Also, call the carrier immediately and retain the shipping carton and packing material for the inspection by the carrier. We will make arrangements to repair or replace the unit.

Remove the PCLD-889 board from its protective packaging carefully. Keep the anti-vibration package. Whenever you are not using the board, please store it in the package for protection.

Discharge any static electricity by touching the back of the system unit before you handle the board. You should avoid contact with materials that create static electricity such as plastic, vinyl, and styrofoam. The board should be handled only by the edges to avoid static electric discharge which could damage the integrated circuits on the PCLD-889.

2.2. Gain Setting

PCLD-889 provides local and remote control and the selection depends on the setting of the switch SW1. Please refer to Appendix B for the SW1 position. The following shows the SW1 setting :



Local Gain Control L : Local

Remote Gain Control R : Remote

Figure 2-2-1

2.2.1. Local Gain Control

When the switch SW1 is set to left, the gain of the amplifier is switch selectable and can be one of the gains of 0.5, 1, 2, 10, 50, 100, 200 and 1000. The specific gain is selected through a DIP switch (SW2) labeled as "GAIN". The following table illustrates the switch setting and corresponding gain.

Switch Position 1	2	3	4	Gain
ON	ON	ON	OFF	0.5
OFF	ON	ON	OFF	1
ON	OFF	ON	OFF	2
OFF	OFF	ON	OFF	10
ON	ON	OFF	OFF	50
OFF	ON	OFF	OFF	100
ON	OFF	OFF	OFF	200
OFF	OFF	OFF	OFF	1000

2.2.2. Remote Gain Control

When the SW1 is set to right side, it means Remote Gain Control is selected and the gain is controlled by the digital signal of connector CN2 bit D4, D5, D6. The bit pattern and related gain is illustrated as :

2.3. Jumper Setting

2.3.1. Filter Selection Jumper

Jumper name: JP0 to JP15

To reject the high frequency noise for the low frequency input signals, the PCLD-889 provides low pass filter on each input channels. Jumper JP0 through JP15 control the use of filtering function on different input channels. For low frequency input signals, such as thermocouple signals, place the jumper on the selected channels. For high frequency signals, remove the jumper on the selected channels.

The low pass filter is constructed with one 1 microfarad capacitor and two 1.2K ohm resistors. The time constant is 2.4 mS, i.e., the cutoff frequency is 417 Hz. If this cutoff frequency is not suitable for the applications, the users can change it by changing the resistors and/or the capacitor.

2.3.2. Analog Output Channel Jumper

Jumper name: JP16

The PCLD-889 supports 10 separate jumper selectable output channels. This feature permits up to 10 PCLD-889's be connected to a 10 channel analog input card. Place the jumper in the output channel according to the channel of the analog input card selected for that PCLD-889 board. The following table illustrates the jumper setting of using the PCLD-889 with the PCL-718.

Output Jumper	PCLD-889 CN1 Pin Assign.	PCL-718 Input Channel	PCL-718 CN1 Pin Assign.
0	1, 2	A/D H0, L0	1, 2
1	3, 4	A/D H1, L1	3, 4
2	5, 6	A/D H2, L2	5, 6
3	7, 8	A/D H3, L3	7, 8
4	9,10	A/D H4, L4	9,10
5	11,12	A/D H5, L5	11,12
6	13,14	A/D H6, L6	13,14
7	15,16	A/D H7, L7	15,16
8	X	X	X
9	X	X	X

Note: " X " means channels are not supported by the PCL-718

If none of the output channel is used, leave the jumper in position "X". If the CJC output is required for thermocouple applications, be aware of the analog output and the CJC output share the connector CN1 output channels. The users must select different channels for the analog output and the CJC output.

2.3.3. CJC Output

Jumper name: JP17

PCLD-889 provides cold-junction compensation (CJC) for the thermocouple applications. If the CJC is required, place the jumper in the position of the channel to be used as a CJC reference. If the CJC is not required, place the jumper in the position "X". Since both the CJC output and the analog output use connector CN1 output channels, the channel used for the CJC output can not be used for any other output.

Connector Name: CN7

CJC also has output on connector CN7. Using a voltage meter measures CN7 two terminal which exists a voltage related to the

PCLD-889 board temperature. The CJC voltage transfers to temperature with the formula :

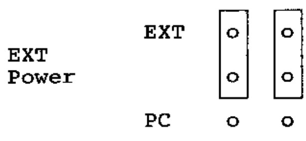
$$T\ (\text{deg.C}) = V * 1000/24.4$$

V : Voltage of CN7.
T : Temperature of PCLD-889 in degree C.

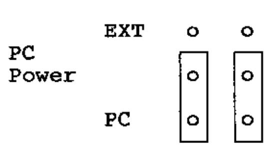
2.3.4. Power Selection Jumper

Jumper name: JP18

To operate the multiplexer, the PCLD-889 needs the +12V and +5V power supply those can be from the data acquisition card or from an external power supply. When PCLD-889 uses external power, JP18 must be inserted two mini-jumpers on the upper position (refer to Section 2.5. Power Supply).



JP18



JP18

2.4. Connector Pin Assignment

The PCLD-889 is equipped with four 20-pin insulation displacement (mass termination) connectors. Connector CN1 and CN3 are pin to pin equivalent for the analog outputs. Connector CN2 and CN4 are pin to pin equivalent for the multiplexer and remote gain control digital inputs, digital ground and +5V, +12V power. Connector CN3 and CN4 are designed to support the PCLD-889 daisy chaining.

All these connectors can be connected to the same type of flat cables. Appendix B specifies the location of each connectors. The following diagrams illustrate the pin assignment of each connector.

Legend :

ANA OUT	-	Analog output
A.GND	-	Analog ground
Dn	-	Digital input
D.GND	-	Digital and power supply ground
+5V	-	+5V power supply from PC.
+12V	-	+12V power supply from PC.

Connector CN1 and CN3 - Analog Output Channels

ANA OUT0	1	2	A.GND
ANA OUT1	3	4	A.GND
ANA OUT2	5	6	A.GND
ANA OUT3	7	8	A.GND
ANA OUT4	9	10	A.GND
ANA OUT5	11	12	A.GND
ANA OUT6	13	14	A.GND
ANA OUT7	15	16	A.GND
ANA OUT8	17	18	A.GND
ANA OUT9	19	20	A.GND

Connector CN2 and CN4 - Multiplexer Input Control, Supply Ground and Power Supply.

D 0	1	2	D 1
D 2	3	4	D 3
D 4	5	6	D 5
D 6	7	8	
	9	10	
	11	12	
	13	14	
	15	16	
D.GND	17	18	D.GND
+ 5V	19	20	+12V

2.5. Power Supply

PCLD-889 requires both +5V and +12V power supply. The connector CN2 pin 19 and 20 are used for the power supply connection. Since the PC offers +5V and +12V power supply, the PCLD-889 can be powered directly from the PC I/O bus by connecting the PCLD-889 with the PCL-718, 812, 711 and other compatible data acquisition cards. Please refer to each product's connector pin assignment for proper connections.

The +12V power input is converted by a DC/DC converter to generate +/-15V DC voltages. This device greatly reduce the noise problem of the input voltage. Each PCLD-889 can draw up to 60mA from the +5V supply and 160mA from the +12V supply. It is important to make sure the power supply of the PC is not overloaded.

The PCLD-889 also can use an external power supply. Connector CN8 is for the external power, that can input +5V, +12V and referring common digital ground. When the user wants to use external power, JP18 must be set to EXT position. Please refer to Appendix B for CN 8 and JP18 position.

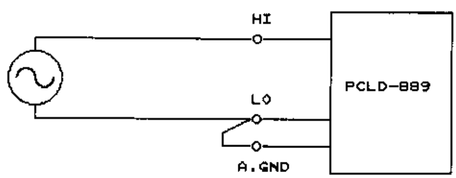
CHAPTER 3. SIGNAL CONNECTION

3.1. Analog Input Connection

PCLD-889 can multiplex up to 16 analog inputs. Input channel selection is controlled by a 4 bit TTL/CMOS digital output data issued by the data acquisition card. The following explains the nature of floating and non-floating signal sources and how to properly connect the input signals.

3.1.1. Floating Source Connection

Since the PCLD-889 has only differential input channels, each input channel must have two signal wires. The differential input responds only to the voltage difference between the high and low inputs. If the signal source has no connection to ground, it is called "floating source". A connection must exist between Low and Ground to define common input voltage for floating signal source. To measure a floating source, the input channel should be connected as :

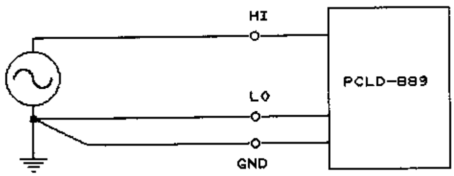


3.1.2. Non-Floating Source Connection

If the signal source has one side connect to a local ground. The signal source ground and the PCLD-889 ground will not be at exactly the same voltage as they are connected through the ground return of the equipment and building wiring. The difference between the ground voltages forms a common mode voltage.

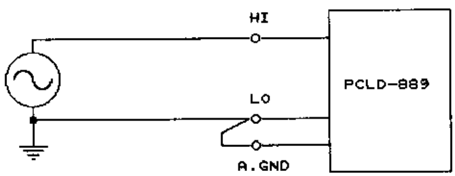
To avoid the ground loop noise effect, the signal ground should be connected to the low input signal. The low input should not be connected to the PCLD-889 ground directly. For better grounding, in some cases, a wire connection between the PCLD-889 ground and signal source ground is necessary. Next two diagrams explain the correct and incorrect connections of a differential input with local ground.

Correct connection:



connected to the PCLD-889 ground directly. For better grounding, in some cases, a wire connection between the PCLD-889 ground and signal source ground is necessary. Next two diagrams explain the correct and incorrect connections of a differential input with local

Incorrect connection:



3.2. Analog Output Connection

The PCLD-889 provides 10 jumper selectable output channels. Users may choose to use any one of the channels to output data. To select a specific output channel, simply place the analog output channel jumper in the desired channel.

The output channel configuration is mainly determined by the pin assignment compatibility between the analog input connector of the data acquisition card and the PCLD-889 output connector. It is also limited by the number of channels available on the data acquisition card. Since the analog input channel configuration are different among the PCL-718, 812 and 711, the details of connecting PCLD-889 outputs to the PCL-718, 812 and 711 are discussed separately in the following sections. The other data acquisition cards follow the same rule and the users can determine the signal connection easily by checking the pin assignments.

3.2.1. Output to the PCL-718

The PCL-718 can handle up to 16 single-ended or 8 differential input channels. Due to the connector pin assignment limitation, only 8 differential input channel configuration can be used. The following table describes the channel connections.

Output Jumper	PCLD-889 CN1 Pin Assign.	PCL-718 Input Channel	PCL-718 CN1 Pin Assign.
0	1, 2	A/D 0	1, 2
1	3, 4	A/D 1	3, 4
2	5, 6	A/D 2	5, 6
3	7, 8	A/D 3	7, 8
4	9,10	A/D 4	9,10
5	11,12	A/D 5	11,12
6	13,14	A/D 6	13,14
7	15,16	A/D 7	15,16
8	X	X	X
9	X	X	X

Note: " X " means channels are not supported by the PCL-718

3.2.2. Output to the PCL-812

The PCL-812 can handle up to 16 signal ended input channels. All of the 10 PCLD-889 output channels can be supported by the PCL-

812 analog input channels. The following table describes the channel connections.

Output Jumper	PCLD-889 CN1 Pin Assign.	PCL-812 Input Channel	PCL-812 CN1 Pin Assign.
0	1, 2	A/D 0, AGND	1, 2
1	3, 4	A/D 1, AGND	3, 4
2	5, 6	A/D 2, AGND	5, 6
3	7, 8	A/D 3, AGND	7, 8
4	9,10	A/D 4, AGND	9,10
5	11,12	A/D 5, AGND	11,12
6	13,14	A/D 6, AGND	13,14
7	15,16	A/D 7, AGND	15,16
8	17,18	A/D 8, AGND	17,18
9	19,20	A/D 9, AGND	19,20

3.2.3. Output to the PCL-711

The PCL-711 can handle up to 8 single-ended input channels. The following table describes the channel connections.

Output Jumper	PCLD-889 CN1 Pin Assign.	PCL-711 Input Channel	PCL-711 CN1 Pin Assign.
0	1, 2	A/D 0, AGND	1, 2
1	3, 4	A/D 1, AGND	3, 4
2	5, 6	A/D 2, AGND	5, 6
3	7, 8	A/D 3, AGND	7, 8
4	9,10	A/D 4, AGND	9,10
5	11,12	A/D 5, AGND	11,12
6	13,14	A/D 6, AGND	13,14
7	15,16	A/D 7, AGND	15,16
8	X	X	X
9	X	X	X

Note: " X " means channels are not supported by the PCL-711

4.1. Gain Settings

The PCLD-889 uses a high grade instrumentation amplifier to provide switch selectable or remote control gains of 0.5, 1, 2, 10, 50, 100, 200 and 1000. Please refer to Section 2.2.1. and 2.2.2. for the gain setting of local and remote control.

If several input signals are connected to a single PCLD-889 simultaneously, to avoid amplifier output saturation, the selected gain should base on the largest input signal. Each type of thermocouple has its suitable gain. To assure correct temperature measurements, do not use local gain control when connecting different types of thermocouples requiring different gains to one PCLD-889. A list of different type of thermocouple and their suitable gains are listed below :

Thermocouple Type	Temperature °C	Output Range (mV)	Suitable Gain
T	-200 to +200	-10 to +10	200
J	-200 to +600	+10 to +35	100
E	0 to +700	-5 to +55	50
K	-200 to +1200	-10 to +55	50
R	0 to +1769	0 to +25	200
S	0 to +1769	0 to +20	200

4.2. Input Channel Selection

The PCLD-889 can multiplex up to 16 differential analog inputs. Input channel selection is controlled by the 4 bit TTL/CMOS digital data (CN2 bit D0 to bit D3) issued by the data acquisition card. The digital signal patterns and their corresponding channels are listed below :

Address	Channel #
0000	0
0001	1
0010	2
.	.
.	.
1111	15

4.3. Output Channel Selection

The PCLD-889 supports 10 separate jumper selectable output channels. The output channel is selected by placing the JP16 (AMP Output) jumper to the desired channel. Please refer to Section 3.2. for more information regarding the channel configuration between the PCLD-889 and the PCL-718, PCL-812 and PCL-711.

4.4. Cascading Multiple PCLD-889's

The PCLD-889 is designed with great flexibility on expanding the analog input channels. If all of the PCLD-889's output channels are used, up to 10 PCLD-889's can be daisy chained to provide 160 channels of standard voltage or current measurement.

For thermocouple measurement, up to 5 PCLD-889's can be cascaded to provide 80 channels thermocouple measurements, if the cold-junction compensation is needed by each PCLD-889. If only one cold-junction compensation is required for all PCLD-889's, up to 9 PCLD-889's can be cascaded to offer 144 channels of thermocouple measurements.

The daisy chaining is accomplished through the connector CN3 and CN4 those are pin to pin equivalent with the connector CN1 and CN2. Each PCLD-889 must be set up with a unique output channel corresponding to an input channel of the data acquisition card.

A diagram illustrates the cascading of multiple PCLD-889's is as following :

4.1. Gain Settings

The PCLD-889 uses a high grade instrumentation amplifier to provide switch selectable or remote control gains of 0.5, 1, 2, 10, 50, 100, 200 and 1000. Please refer to Section 2.2.1. and 2.2.2. for the gain setting of local and remote control.

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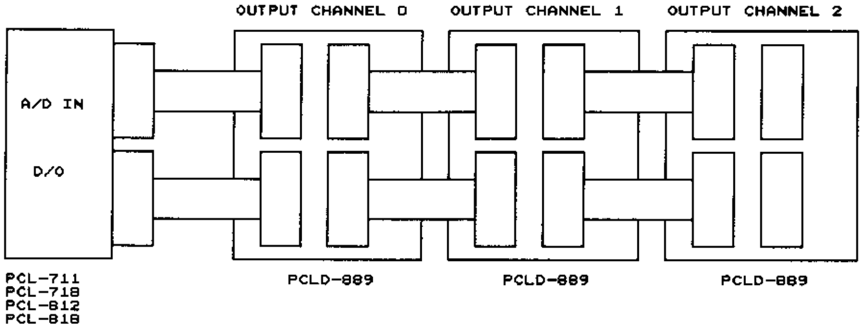
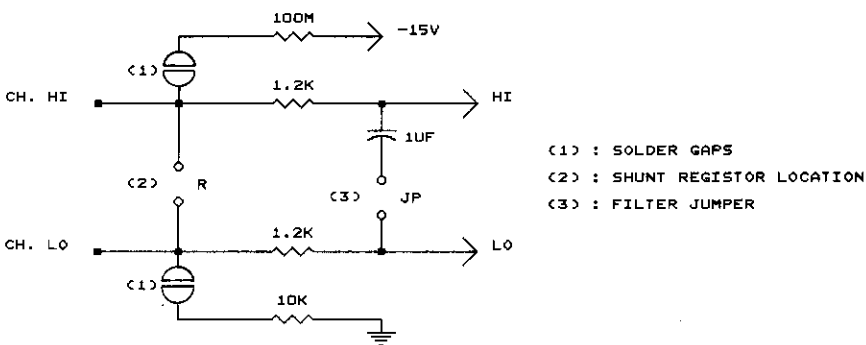
A diagram illustrates the cascading of multiple PCLD-889's is as following :



4.5. Open Thermocouple Detection

The PCLD-889 provides open thermocouple detection through a biasing resistor circuitry. These bias resistors are normally not connected. On the back of the board, the user can find two solder gaps for each input channel. If the open thermocouple detection is required, short the solder gaps to connect the biasing resistors.

Under a normal condition, the input voltage generated by a thermocouple is very small. If a thermocouple opens, the bias resistors will slowly pull the input voltage to -10V. This significant input voltage changes will signify the open thermocouple. The user can use a simple application program to detect the voltage changes of the open thermocouple. The following diagram illustrates the open thermocouple detection circuitry :



CHAPTER 5. APPLICATIONS

This chapter provides the information of using the PCLD-889 in different applications. Since the PCLD-889 is a daughter board, it must be used with the data acquisition card. This chapter covers the use of some data acquisition cards with the PCLD-889 through application examples. It also provides explanations on how to use the PCLD-889 with transducer and thermocouple. All application programs mentioned in this chapter are contained in the PCLD-889 software disk.

5.1. Using with the PCL-718

The PCL-718 (High Performance Data Acquisition Card) can support up to 128 input channels by cascading 8 PCLD-889's. Since the PCL-718 comes with a software driver, the user may use this driver in application programming or write application programs without using the PCL-718 driver routines.

This section will use a T type thermocouple measurement application to demonstrate how to use the PCLD-889 with the PCL-718 data acquisition card. Please note that this application program, DEMO718A.BAS, is written in BASIC and utilizes the PCL-718 driver routines. The major steps of the program are listed below :

Step 1 : Load PCL718.BIN driver to BASICA work space.

Step 2 : Use PCL-718 driver Function 0 to initialize driver.

Step 3 : Load thermocouple voltage/temperature conversion table to array, define A/D data array and input selected gain option.

Step 4 : Get cold-junction compensation reference from PCLD-889.

Step 5 : Get thermocouple analog inputs using Function 3 (single A/D conversion).

Step 6 : Convert A/D data to volts with specified gain and further convert voltage data to temperature data.

Step 7 : Display temperature data.

A subroutine contains different types of thermocouple voltage/ temperature conversion parameters and calculation routines are used in program DEMO718A.BAS. To help the users writing thermocouple application programs, a subroutine program, called THERMO.BAS, written in BASIC is provided in the PCLD-889 software disk.

5.2. Using with the PCL-812

The PCL-812 can support up to 160 input channels by cascading 10 PCLD-889's. This section will use a J type thermocouple measurement application to demonstrate how to use the PCLD-889 with the PCL-812 data acquisition card. Please note that this application program, DEMO812.BAS, is written in BASIC and handles all PCL-812 I/O port instructions directly. The major steps of the program are listed below :

Step 1 : Load thermocouple voltage/temperature conversion table to array and select J type measurement.

Step 2 : Define A/D data and temperature data arrays and input selected gain option.

Step 3 : Get cold-junction compensation reference from PCLD-889.

Step 4 : Get thermocouple analog inputs.

Step 5 : Convert A/D data to volts with specified gain and further convert voltage data to temperature data.

Step 6 : Display temperature data.

5.3. Using with the PCL-711

The PCL-711 (Multi-Lab Card) can support up to 128 input channels by cascading 8 PCLD-889's. This section will use a J type thermocouple measurement application to demonstrate how to use the PCLD-889 with PCL-711 data acquisition card. Please note that this application program, DEMO711.BAS, is written in BASIC and handles all PCL-711 I/O port instructions directly. The major steps of the program are listed below:

Step 1 : Load thermocouple voltage/temperature conversion table to array and select J type measurement.

Step 2 : Define A/D data and temperature data arrays and input selected gain option.

Step 3 : Get cold-junction compensation reference from PCLD-889.

Step 4 : Get thermocouple analog inputs.

Step 5 : Convert A/D data to volts with specified gain and further convert voltage data to temperature data.

Step 6 : Display temperature data.

5.4. Cascading Multiple PCLD-889's

This section will provide an application example of using 5 PCLD-889's to measure 80 points analog signals with the PCL-718 data acquisition card. Please note that the application program, DEMO718B.BAS, is written in BASIC and utilizes the PCL-718 driver routines. The major steps of the program are listed below :

Step 1 : Load PCL718.BIN driver to BASICA work space.

Step 2 : Use PCL-718 driver Function 0 to initialize driver.

Step 3 : Define data arrays and obtain each PCLD-889's gain setting.

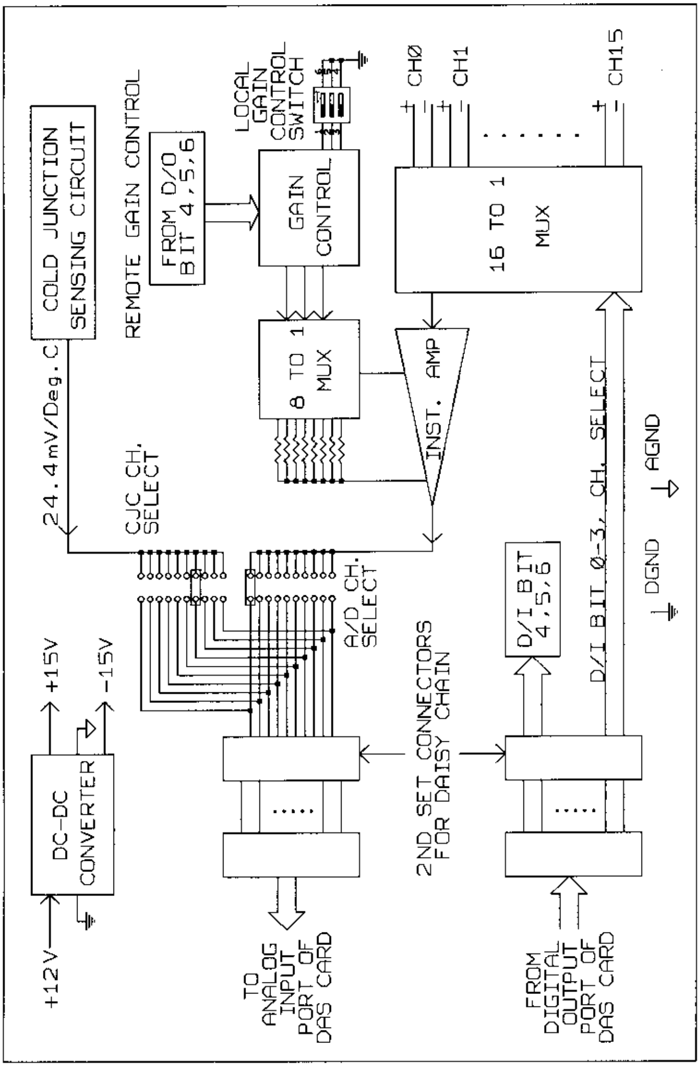
Step 4 : Get PCLD-889 input signals using PCL-718 driver functions.

Step 5 : Convert A/D data to volts with specified gain.

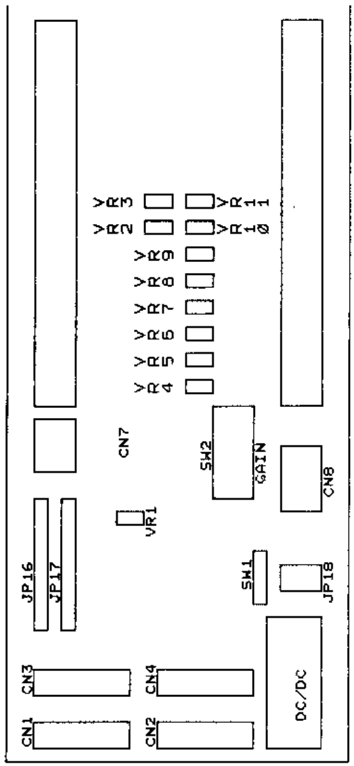
Step 6 : Display measured data.

Step 7 : Repeat Step 4 through 6 for next PCLD-889.

APPENDIX A BLOCK DIAGRAM



APPENDIX B CONNECTOR, JUMPER AND VR LOCATIONS



APPENDIX C CALIBRATION

In the application of data acquisition and control, it is important to constantly calibrate your measurement device to maintain its accuracy. A calibration program, CALB889.BAS, is provided in the PCLD-889 software disk to assist your calibration work.

The calibration program is written in BASICA. To use it, simply load the program into the BASICA and run the program. It is strongly recommend that users do not change the program unless it is really necessary.

Once the calibration program has been loaded and executed, it uses the graphic display and prompts to guide you through the calibration process.

In addition to the calibration program, it is necessary to have at least a 4 1/2 digit digital voltmeter (DVM), a voltage calibrator or very stable and noise free DC voltage source to perform the amplifier offset and gain calibration. For the cold-junction compensation circuitry calibration, a digital thermometer or other temperature measurement device with +/-0.5 deg. C accuracy is required. Any data acquisition card or DIO card with digital output port of Advantech type is necessary to operate the PCLD-889 for calibration. A terminal board such as PCLD-780 is also very useful for signal connections.

C.1. Calibrating the Amplifier Offset

The amplifier offset calibration includes input offset and output offset adjustments. The complete procedure of conducting the offset calibration is as following :

1. Connect the PCLD-889 connector CN2 to the digital output port of a compatible data acquisition card, e.g. PCL-718, to obtain the signal of channel/gain control and the power supply of +5V /+12V.

2. Short the terminals of the selected analog input channel by wiring the analog ground, high input and low input together. For example, if the input channel 7 is selected, the A.GND and CH7 HI and CH7 LO should be shorted.

3. Put the analog output jumper in any one of the output channel.

4. Identify the pins of the selected output channel and analog ground in the connector CN1 and connect these pins to the high, low input of the DVM.

5. Adjust the input offset by setting the gain switch to 1000 or 200 and tuning the VR2 to obtain zero reading on the DVM.

6. Adjust the output offset by setting the gain switch to 0.5 or 1 and tuning the VR3 to obtain zero reading on the DVM.

C.2. Calibrating the Amplifier Gains

The PCLD-889 amplifier gain calibrations are controlled by the VR4 through VR11. The corresponding gain of each VR is listed below:

VR4: Gain = 0.5	VR8 : Gain = 50
VR5: Gain = 1	VR9 : Gain = 100
VR6: Gain = 2	VR10: Gain = 200
VR7: Gain = 10	VR11: Gain = 1000

The steps of performing amplifier gain calibration are as following :

1. Connect the PCLD-889 connector CN2 to the digital output port of a compatible data acquisition card, e.g. PCL-718, to obtain the signal of channel/gain control and the power supply of +5V /+12V.

2. Connect the analog input wires from the calibrator to the desired input terminal ports. The Section 3.1. covers the details of analog input connections.

3. Put the analog output jumper in any one of the output channel.

4. Identify the pins of the selected output channel and analog ground in the connector CN1 and connect these pins to the input and common of the DVM.

5. Adjust the 0.5 gain offset by setting the gain switch to 0.5 and tuning the VR4 to obtain required reading on the DVM. The required reading is based on the input voltage and gain setting. For example, if the input voltage is +2V, the required reading should be +1V.

6. Repeat the STEP 5 until all of the gains have been calibrated.

C.3. Calibrating the CJC Circuitry

As soon as the cold-junction compensation circuitry calibration function has been selected, please following the steps listed below to perform the calibration.

1. Put the CJC jumper in any one of the CJC output channel.

2. Identify the previous step selected channel output and ground pins in the connector CN1 and connect these pins to the DVM input and ground ports.

3. Use the digital thermometer to measure the temperature around the temperature sensor CR2. To assure the correct measurement, put the temperature sensor of the thermometer next to the CR2.

4. Since the PCLD-889 CJC circuitry generates a +24.4 mV/deg.C compensation signal with a zero volt output at 0 deg. C., the corresponding voltage of the measured temperature can be calculated by the following formula :

   Vt = (24.4mV/deg. C) * Measured Temperature.

5. Adjust the VR1 to obtain a DVM reading equal to the voltage (Vt) calculated in the previous step.